CLAIMS

1. A high PRF plasma gun including:

a center electrode;

an outer electrode substantially coaxial with said center electrode, a coaxial column being formed between said electrodes, which column has a closed base end and an open exit end;

an inlet mechanism for introducing a selected gas into said column;

a plasma initiator at the base end of said column;

a solid state simulated RF source selectively connected to drive said plasma initiator; and

a solid state, high repetition rate pulsed driver operable on plasma initiation at the base of said column for delivering a high voltage pulse across said electrodes, the plasma expanding from the base end of the column and off the exit end thereof.

2. A plasma gun as claimed in claim 1, wherein said RF source is operating at a frequency in the range of 10 MHZ to 1000 MHZ.

3. A plasma gun as claimed in claim 1 wherein said simulated RF source includes an N stage non-linear magnetic pulse compressor, where N is an integer ≥ 1;

a solid state switch selectively operable for connecting an energy storage device to an input of a first stage of said compressor;

an output stage having a resonant circuit at an RF frequency F to be simulated, said resonant circuit including a capacitor C_R and a saturable reactor L_R, a last stage of said compressor having a capacitance C_N, at least one of C_R and L_R being selected so that there is a reverse voltage on C_N before C_R is fully charged, L_R successively saturating to cause oscillating of C_R at frequency F; and

a coupling circuit for coupling energy from C_R to drive said plasma initiator.

4. A plasma gun as claimed in claim 2, wherein said solid state switch is one of an SCR, an IGBT and a MOSFET.

5. A plasma gun as claimed in claim 2, wherein C_R is selected such that $C_R > C_N$.

6. A plasma gun as claimed in claim 3, wherein N_R is selected such that it saturates before transfer of charge from C_N to C_R is completed.

7. A plasma gun as claimed in claim 2, wherein said output stage is a resonant saturable shunt to ground.

8. A plasma gun as claimed in claim 2, wherein said coupling circuit has an impedance such that only a fraction of the energy stored in C_R is coupled to said plasma initiator during each oscillating cycle of C_R.

9. A plasma gun as claimed in claim 2, wherein L_R and C_R are selected such that there are only 3 to 4 oscillating cycles of said output stage.

10. A plasma gun as claimed in claim 1, wherein said plasma initiator is a plurality of electrodes affixed to an insulator and spaced substantially uniformly about said column, said electrodes producing a high voltage field at a surface of said insulator which surface is at the base end of said column.

11. A plasma gun as claimed in claim 9, wherein said insulator surrounds said center electrode at a base end thereof, and wherein said electrodes are mounted to said insulator near the base end of said column.

12. A plasma gun as claimed in claim 9, wherein said insulator forms a base of said column, and wherein said electrodes are mounted in said insulator from a side thereof opposite said column and spaced a short distance from said column by said insulator, energizing of said electrodes producing a high voltage field at a side of said insulator in said column.

13. A plasma gun as claimed in claim 1, wherein at least one of said center electrode and said outer electrode is formed of a sintered powder refractory metal.

14. A plasma gun as claimed in claim 13, wherein said plasma gun is operating as a radiation source at a selected wavelength, and wherein said at least one electrode is saturated with a fluid material suitable for generating radiation at the selected wavelength.

15. A plasma gun as claimed in claim 14, wherein the fluid is liquid lithium.

16. A plasma gun as claimed in claim 14, including a mechanism which provides said fluid material to the at least one electrode on a substantially continuous basis.

17. A plasma gun as claimed in claim 13, wherein both said center electrode and said outer electrode are formed of said sintered powder refractory material.

18. A plasma gun as claimed in claim 1, wherein said pulsed driver provides a high voltage spike followed by a lower voltage, longer duration sustainer signal, most of the driver energy being provided by the sustainer signal.

19. A plasma gun as claimed in claim 18, wherein said pulsed driver includes a first non-linear magnetic pulse driver for generating said high voltage spike and a second non-linear magnetic pulse driver for generating said sustainer signal.

20. A plasma gun as claimed in claim 19, wherein said second driver has at least two stages, a saturable reactor of a last of said stages being normally biased to prevent the spike from said first driver entering the second driver, the spike partially desaturing said reactor to inhibit initial flow from said second driver until the reactor again saturates to pas the sustaining signal.

21. A high PRF plasma gun including:

a center electrode;

an outer electrode substantially coaxial with said center electrode, a coaxial column being formed between said electrodes, which column has a closed base end and an open exit end;

an inlet mechanism for introducing a selected gas into said column;

a plasma initiator at the base end of said column, said plasma initiator including a plurality of electrodes affixed to an insulator and spaced substantially uniformly about said

column, said electrodes when driven producing a high voltage field at a surface of said insulator which surface is at the base end of said column; and

a solid state, high repetition rate pulsed driver operable on plasma initiation at the base of said column for delivering a high voltage pulse across said electrodes, the plasma expanding from the base end of the column and off the exit end thereof.

22. A plasma gun as claimed in claim 21, wherein said insulator surrounds said center electrode at a base end thereof, and wherein said electrodes are mounted to said insulator near the base end of said column.

23. A plasma gun as claimed in claim 21, wherein said insulator forms a base of said column, and wherein said electrodes are mounted in said insulator from a side thereof opposite said column and spaced a short distance from said column by said insulator, energizing of said electrodes producing a high voltage field at a side of said insulator in said column.

24. A simulated RF source including:

an N stage non-linear magnetic pulse compressor, where N is an integer ≥ 1;

a solid state switch selectively operable for connecting an energy storage device to an input of a first stage of said compressor;

an output stage having a resonant circuit at an RF frequency F_1 to be simulated, said resonant circuit including a capacitor C_R and a saturable reactor L_R, a last stage of said compressor having a capacitance C_N, at least one of C_R and L_R being selected so that there is a reverse voltage on C_N before C_R is fully charged, L_R successively saturating to cause oscillating of C_R at frequency F; and

a coupling circuit for coupling out energy from C_R.

25. A high PRF plasma gun including:

a center electrode;

an outer electrode substantially coaxial with said center electrode, a coaxial column being formed between said electrodes, which column has a closed base end and an open exit end, at least one of said center electrode and said outer electrode being formed of a sintered powder refractory metal;

an inlet mechanism for introducing a selected gas into said column;

a selectively driven plasma initiator at the base end of said column; and

a solid state, high repetition rate pulsed driver operable on plasma initiation at the base of said column for delivering a high voltage pulse across said electrodes, the plasma expanding from the base end of the column and off the exit end thereof.

26. A plasma gun as claimed in claim 25, wherein said plasma gun is operating as a radiation source at a selected wavelength, and wherein said at least one electrode is saturated with a fluid material suitable for generating radiation at the selected wavelength.

27. A plasma gun as claimed in claim 26, wherein the fluid is liquid lithium.

28. A plasma gun as claimed in claim 26, including a mechanism which provides said fluid material to the at least one electrode on a substantially continuous basis.

29. A plasma gun as claimed in claim 25, wherein both said center electrode and said outer electrode are formed of said sintered powder refractory material.

30. A high PRF plasma gun including:

a center electrode;

an outer electrode substantially coaxial with said center electrode, a coaxial column being formed between said electrodes, which column has a closed base end and an open exit end;

an inlet mechanism for introducing a selected gas into said column;

a selectively driven plasma initiator at the base end of said column; and

a solid state, high repetition rate pulsed driver operable on plasma initiation at the base of said column for delivering a high voltage pulse across said electrodes, said pulsed driver providing a high voltage spike followed by a lower voltage, longer duration sustainer signal, most of the driver energy being provided by the sustainer signal, the plasma expanding from the base end of the column and off the exit end thereof.

29 ~~31~~. A plasma gun as claimed in claim 28 ~~30~~, wherein said pulsed driver includes a first non-linear magnetic pulse driver for generating said high voltage spike and a second non-linear magnetic pulse driver for generating said sustainer signal.

30 ~~32~~. A plasma gun as claimed in claim 29 ~~31~~, wherein said second driver has at least two stages, a saturable reactor of a last of said stages being normally biased to prevent the spike from said first driver entering the second driver, the spike partially desaturing said reactor to inhibit initial flow from said second driver until the reactor again saturates to pass the sustaining signal.